anatomically appropriate, and physiologically higher risk patients with moderate sized aneurysms who can tolerate the time required for customized graft planning and manufacturing.

Conclusion

When restricting the discussion to Type IV thoracoabdominal aneurysms, the choices are clear. In the vast majority of patients, deemed candidates for repair, open repair remains the preferred option. Hybrid repairs have limited applicability and should be reserved for specific anatomic patterns, usually involving redo aortic surgery and more urgent presentations. Although promising, wider adoption of a totally endovascular approach for Type IV TAAAs is not currently appropriate and this technology should be reserved for those physiologically higher risk patients at centers with sufficient experience.

References

1 Safi HJ, Estrera AL, Azizzadeh A, Coogan S, Miller CC. Progress and future challenges in thoracoabdominal aortic aneurysm management. *World J Surg* 2008;**32**:355–60.
2 Patel R, Conrad MF, Paruchuri V, Kwolek CJ, Chung TK, Cambria RP. Thoracoabdominal aneurysm repair: hybrid versus open repair. *J Vasc Surg* 2009;**50**(1):15–22.
3 Greenberg RK, Lu Q, Roselli EE, Svensson LG, Moon MC, Hernandez AV, et al. Contemporary analysis of descending thoracic and thoracoabdominal aneurysm repair: a comparison of endovascular and open techniques. *Circulation* 2008;**118**(8):808–17.
4 Conrad MF, Cambria RP. Contemporary management of descending thoracic and thoracoabdominal aortic aneurysms: endovascular versus open. *Circulation* 2008;**117**(6):841–52.
5 Wong DR, Parenti JL, Green SY, Chowdhary V, Liao JM, Zarda S, et al. Open repair of thoracoabdominal aortic aneurysm in the modern surgical era: contemporary outcomes in 509 patients. *J Am Coll Surg* 2011;**212**:569–81.
6 Rigberg DA, McGory ML, Zingmond DS, Maggard MA, Agustin M, Lawrence PF, et al. Thirty-day mortality statistics underestimate the risk of repair of thoracoabdominal aortic aneurysms: a statewide experience. *J Vasc Surg* 2006;**43**(2):217–22. discussion 23.
7 Quinones-Baldrich WJ, Panetta TF, Vescera CL, Kashyap VS. Repair of type IV thoracoabdominal aneurysm with a combined endovascular and surgical approach. *J Vasc Surg* 1999;**30**(3):555–60.
8 Resch TA, Greenberg RK, Lyden SP, Clair DG, Krajewski L, Kashyap VS, et al. Combined staged procedures for the treatment of thoracoabdominal aneurysms. *J Endovasc Ther* 2006;**13**(4):481–9.
9 Anderson JL, Adam DJ, Berce M, Hartley DE. Repair of thoracoabdominal aortic aneurysms with fenestrated and branched endovascular stent grafts. *J Vasc Surg* 2005;**42**(4):600–7.
10 Sweet MP, Hiramoto JS, Park KH, Reilly LM, Chuter TA. A standardized multi-branched thoracoabdominal stent-graft for endovascular aneurysm repair. *J Endovasc Ther* 2009;**16**(3):359–64.

doi: 10.1016/j.ejvs.2011.05.005

EDITORS' COMMENT

Treatment of Type IV Thoracoabdominal Aneurysms — Open, Hybrid Technique with Debranching or Fenestrated Stent-graft Repair

J.-B. Ricco [a,*], T.L. Forbes [b]

[a] *European Journal of Vascular and Endovascular Surgery, 86021 Poitiers, France*
[b] *Journal of Vascular Surgery, London, Ontario, Canada*

Numerous comparisons have been conducted between open repair (OR) and endovascular repair (ER) of aortic aneurysm including randomized controlled trials (RCT) involving infrarenal aortic aneurysms. But no such RCT exists for type IV thoracoabdominal aneurysms (Type IV-TAA) due to several limitations including poor-risk patients that are not eligible for randomization, the need for a large number of patients and surgeons with a high level of endovascular skills required for branched endovascular stent-grafts.

Consequently, the authors have to rely on uncontrolled clinical series comparing these different techniques, i.e. conventional OR, ER, and hybrid techniques for patients with variable risk factors.

In this debates limited to Type IV-TAA, Haulon et al. reported outstanding results in a large series of 231 patients treated by a fenestrated stent-graft with no intraoperative mortality, 2.6% of mortality at 30-day, 1% of spinal cord ischemia (SCI) and no aneurysm rupture at 2-year with the use of 44 secondary procedures, but generalization of these excellent results will be difficult to obtain.

Interestingly enough, coming from the same institution, Greenberg et al.[1] reported the results of a consecutive cohort of patients with thoracic and thoracoabdominal aneurysms treated electively with ER or OR. In this large comparative series, the subset of patients with type IV-TAA demonstrated comparable incidences of 30-day mortality (4% and 6% for ER and OR respectively) and of SCI (3% and 2% for ER and OR respectively). However OR was offered more often to healthier patients. On the basis of this series, it is clear that ER of type IV TAA is feasible and produces results similar to OR even in more frail patients.

Considering OR, adjunctive measures such as distal aortic perfusion, cerebrospinal fluid drainage, intercostal artery attachment have also helped to reduce the 30-day mortality, SCI and renal failure rates to 3.4%, 1.4% and 5.4% respectively with a durable procedure and very low rates of aneurysm-related complications in the long-term

* Corresponding author. Tel.: +33 5 49 44 38 46; fax:+33 5 49 50 05 50.
E-mail address: jeanbaptistericco@gmail.com (J.-B. Ricco).

follow-up.[2] However as for ER, the ability to disseminate this conventional surgical technique is the subject of controversies. A review of the nationwide inpatient sample database showed that perioperative mortality for TAA was 22.3%[3] and 19% in a California statewide study[4] emphasizing the need for centralization of these patients in high volume centers.

In this arena, visceral hybrid technique combining extra-anatomical debranching and simple aortic aneurysm exclusion by a stent-graft, was designed to avoid some of the difficulties seen with OR and ER of type IV-TAA.[5] This hybrid technique has been adopted by some centers despite a 30-day mortality rate of 10.7%[6] and unproven durability. Very little data specific to this approach for type IV-TAA have been published. Such procedures could be used in rare cases when both conventional OR and ER are contraindicated, or in acute situation with manufacturing delays or for funding considerations that could limit the use of branched stent-grafts.

We have no level evidence 1 to conclude this debate, but in fit patients ER and conventional OR demonstrate similar incidences of paraplegia and 30-day mortality with less reoperation and durability in favor of OR. But ER with branched stent-grafts incorporating axial branches or helical branches has been used with early and mid-term satisfactory results in frail patients. However durability of such branched stent-grafts remains to be known with concerns about the strength of modular joints and the potential to develop dilatation at the proximal and distal sealing aortic segments.

References

1 Greenberg RK, Lu Q, Roselli EE, Svensson LG, Moon MC, Hernandez AV, et al. Contemporary analysis of descending thoracic and thoracoabdominal aneurysm repair: a comparison of endovascular and open techniques. *Circulation* 2008;**118**:808—17.

2 Coselli JS, Bozinovski J, LeMaire SA. Open surgical repair of 2286 thoracoabdominal aortic aneurysms. *Ann Thorac Surg* 2007;**83**: S862—4.

3 Cowan Jr JA, Dimick JB, Henke PK, Huber TS, Stanley JC, Upchurch Jr GR. Surgical treatment of intact thoracoabdominal aortic aneurysms in the United States: hospital and surgeon volume-related outcomes. *J Vasc Surg* 2003;**37**:1169—74.

4 Rigberg DA, McGory ML, Zingmond DS, Maggard MA, Agustin M, Lawrence PF, et al. Thirty-day mortality statistics underestimate the risk of repair of thoracoabdominal aortic aneurysm: a statewide experience. *J Vasc Surg* 2006;**43**:217—23.

5 Quinones-Baldrich WJ, Panetta TF, Vescera CL, Kashyap VS. Repair of a type IV thoracoabdominal aneurysm with a combined endovascular and surgical approach. *J Vasc Surg* 1999;**30**: 555—60.

6 Donas KP, Czerny M, Guber I, Teufelsbauer H, Nanobachvili J. Hybrid open-endovascular repair for thoracoabdominal aortic aneurysms: current status and level of evidence. *Eur J Vasc Endovasc Surg* 2007;**34**:528—33.

doi: 10.1016/j.ejvs.2011.04.001